



# Traverse City Regional Wastewater Treatment Plant Membrane Replacement Update



*City Commission and Grand Traverse County Board of  
Public Works Joint Study Session  
December 8, 2014*

# Agenda

- Background
- Revised Membrane Configuration
- Wet Weather, High-Flow Events
- Membrane Permeability
- Risk of Impaired Permeability
- Recommendations
- Discussion

# Background

- CH2M Hill has operated the Traverse City RWWTP since 1990
- Plant was converted to membrane bioreactor (MBR) process - began producing high-quality membrane-filtered effluent July 2004
- Original membranes from Train 1 were redistributed to other trains (mid 2014)
- New membranes installed in Train 1 (Oct. 2014)
- New membranes have dramatically higher permeability than original membranes.
- Two “near misses” and other signs that original membranes are near end of life
- Recommend replacing 4 trains in 2015 and 3 remaining trains in 2016





# Original Membrane Configuration



# Current Membrane Configuration



# Wet Weather, High-Flow Events in 2014

Parameter	April 14th	September 5th	Notes
Storm duration	~10 hours	~4 hours	
Monthly average flow	5.0 mgd	4.7 mgd	Plant capacity 8.5 mgd
Daily average flow	7.0 mgd	6.5 mgd	
Peak flow	9-10 mgd	9-10 mgd	Plant capacity 17 mgd
Process temperature	11°C	20°C	
Permeability	50%	75%	Relative to normal

- Temporary decrease in permeability
- Not associated with gram positive bacteria
- Intensive, manual plant operation required to prevent spill

# Membranes Very Near End of Life

- More frequent cleaning required to maintain permeability.
- Train 8 permeability not restored by chemical cleaning – had to be cleaned twice
- Train 7 failed “flow test” (performed 3 months after a recovery clean)

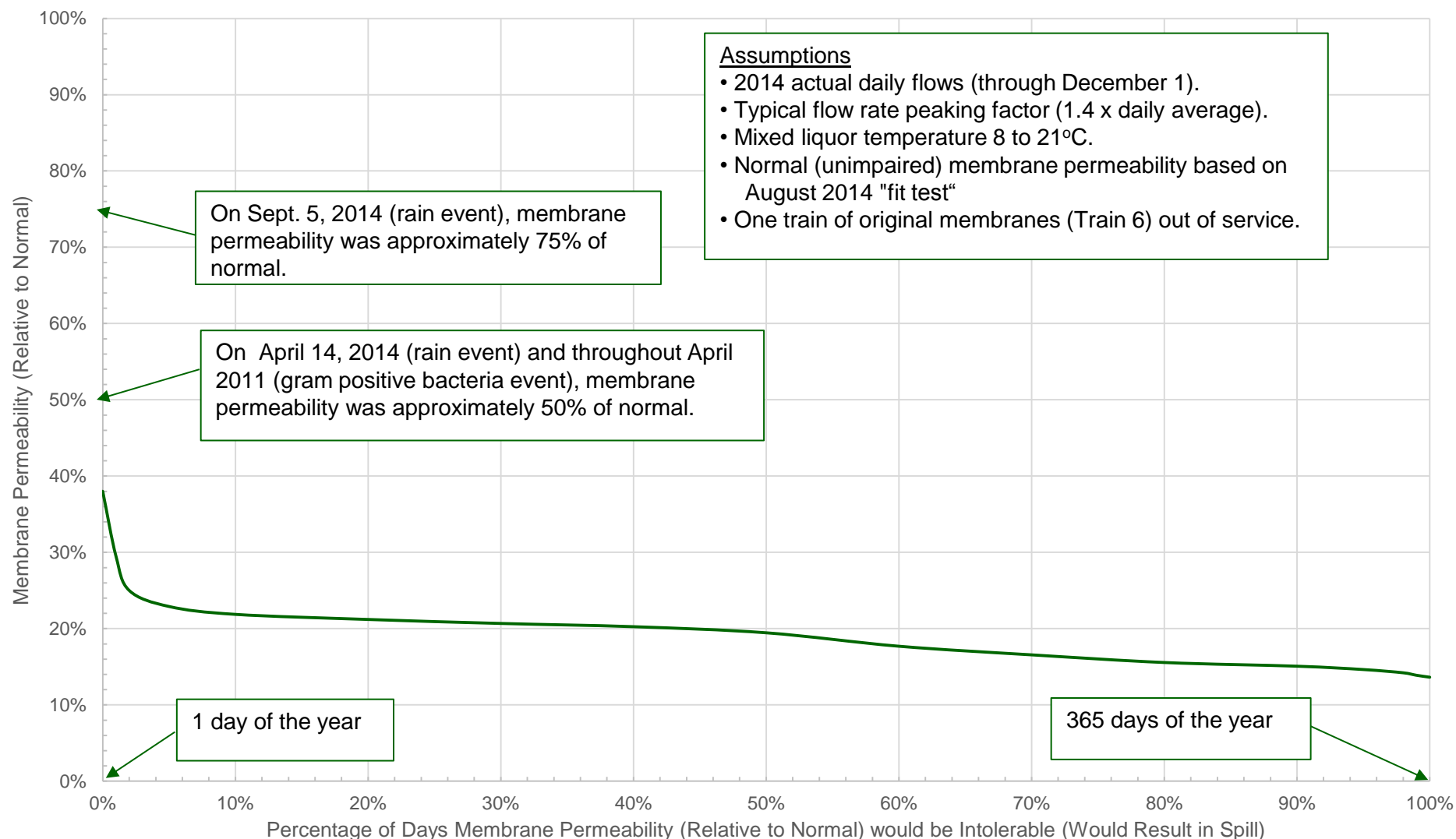
# October 2014 Membrane “Fit” Test

Train	Normalized Permeability (gfd/psi)	Relative
1 (new membranes)	21.0	100%
2	6.3	30%
3	6.0	29%
4	7.4	35%
5	7.4	35%
6	8.7	41%
7	6.1	29%
8	6.8	32%

- Trains 2-8 show differences in permeability despite being same age.
- Poorest performing membrane trains should be replaced next.



# Risk of Impaired Permeability – Year Like 2014



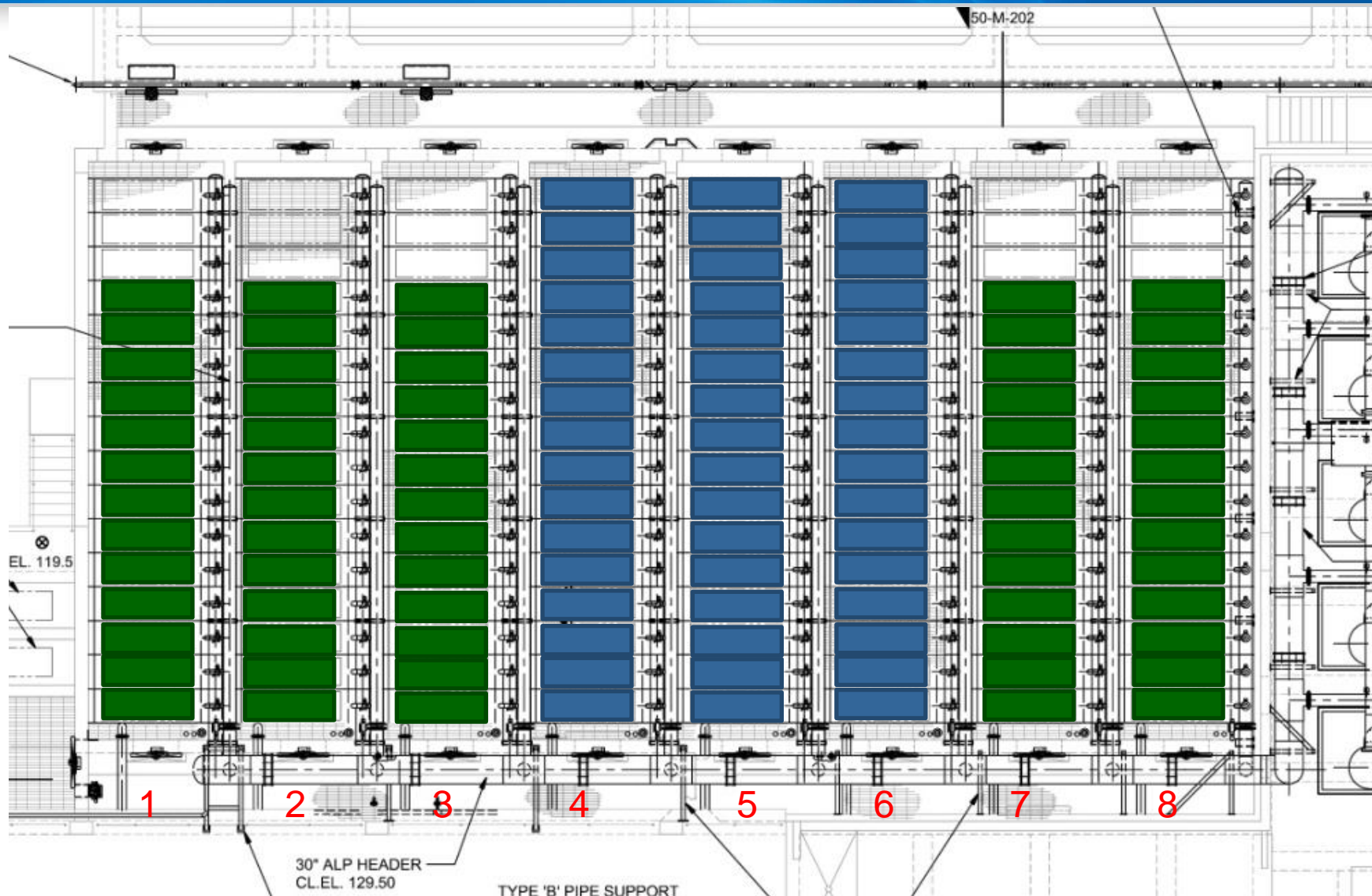
# Factors Affecting Risk of Impaired Permeability

- Higher peak flows have occurred than those in 2014.
- Lower process temperatures have occurred than those coinciding with 2014 peak flows.
- Permeability impairment due to gram positive bacteria continues to occur unexpectedly and could coincide with future peak flows.
- Train 1 (new membranes) could be out of service rather than train 6 (original membranes).
- Performance of original membranes will continue to decrease at uncertain rate.

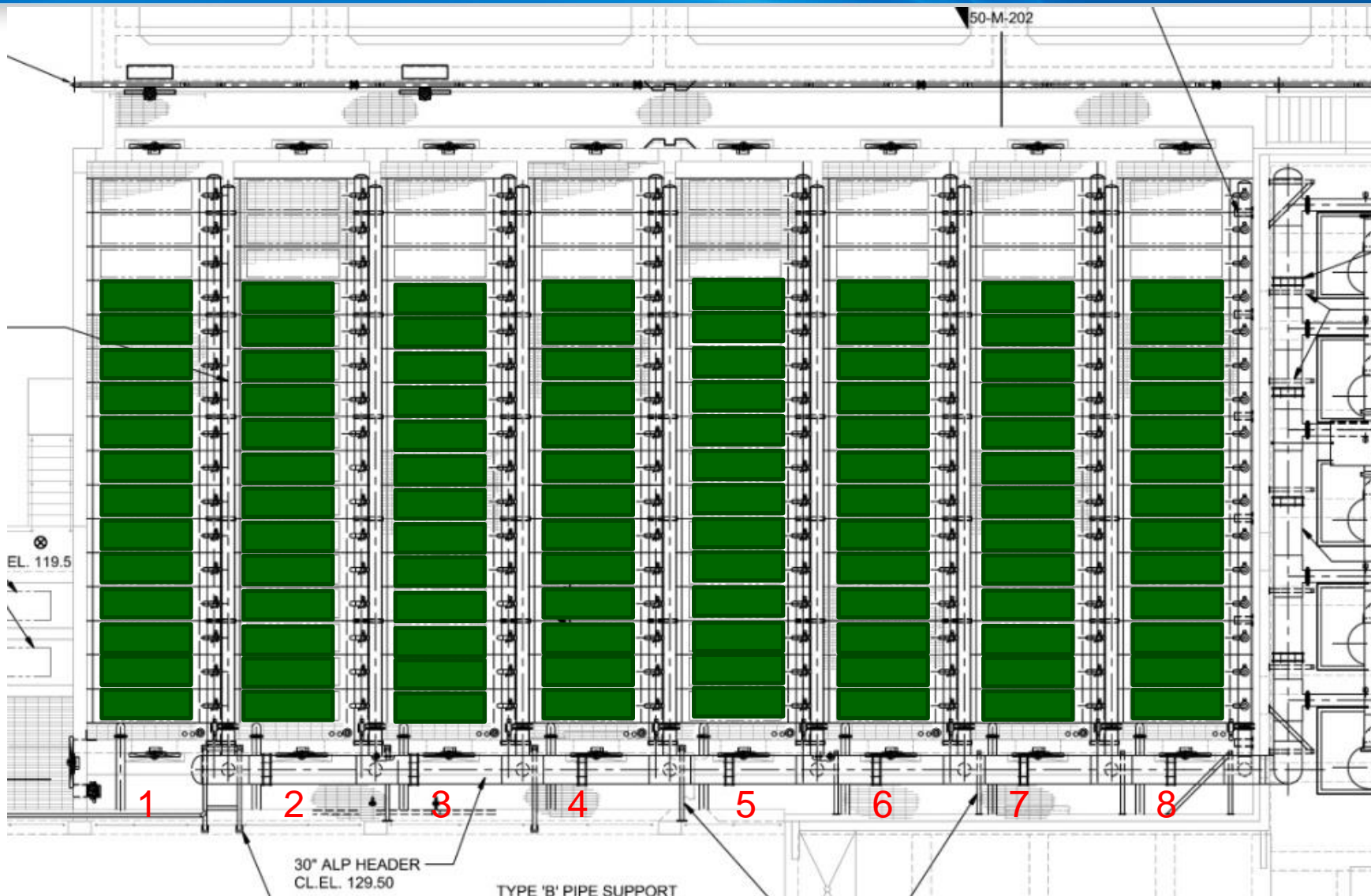
# Recommendations

- Replace 4 membrane trains in 2015, remaining 3 trains in 2016.
- Membrane replacement cost updated from last year
  - \$823,000 per train (Sept. 2014 dollars)
  - Previously agreed upon membrane pricing, scaled using consumer price index (US CPI-U)
  - GE design cost no longer applies
  - Includes cost of membrane tank repair/recoating
  - Installation cost includes less GE services / more CH2M HILL services
- 4 trains in 2015 → \$3.3 million
- 3 trains in 2016 → \$2.5 million
- Future membrane replacement
  - Plan for 4 trains in 2025, 4 trains in 2026
  - Less expensive (in 2014 dollars) because only new modules needed

# 2015 Recommended Membrane Configuration



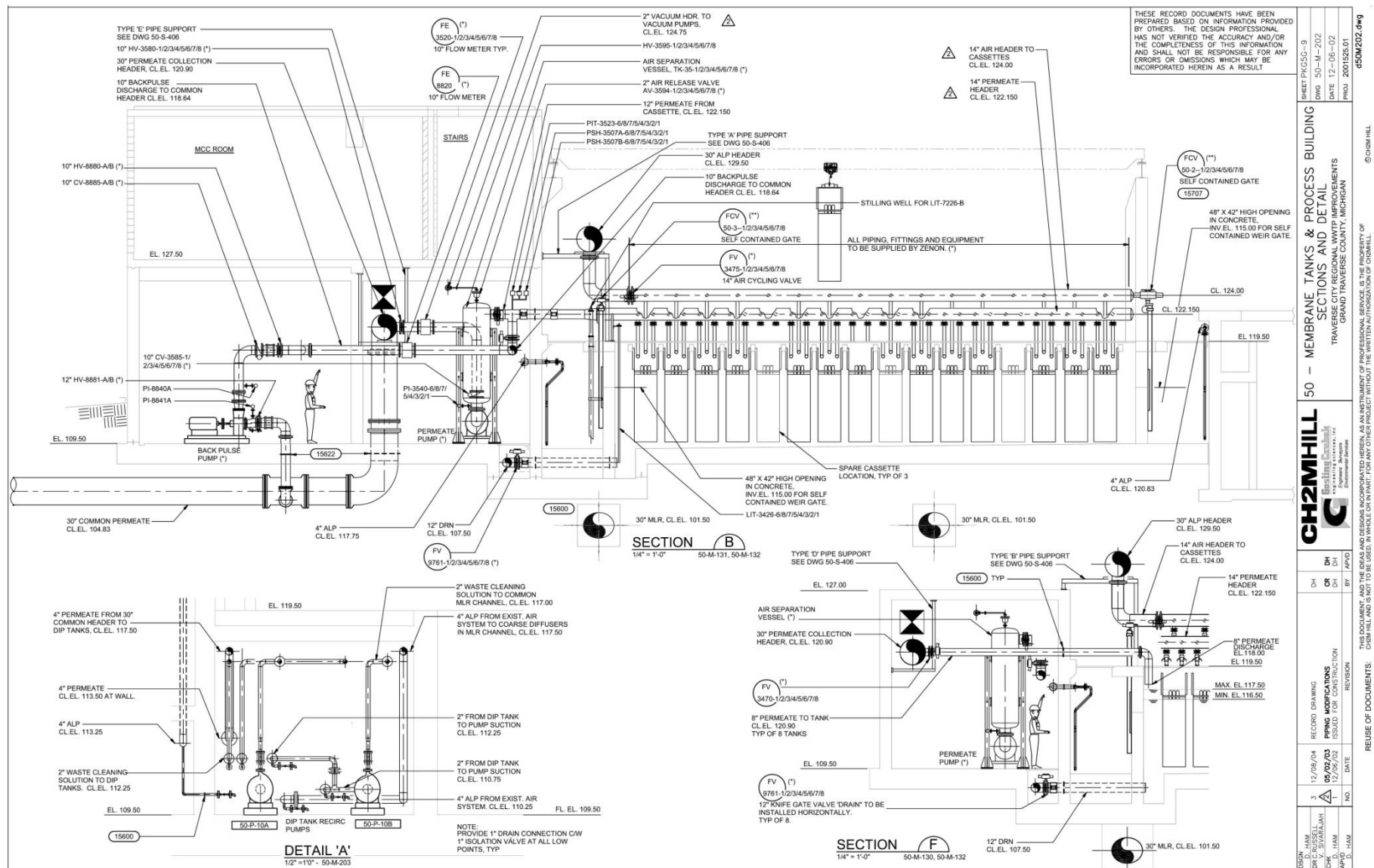
# 2016 Recommended Membrane Configuration





# Discussion

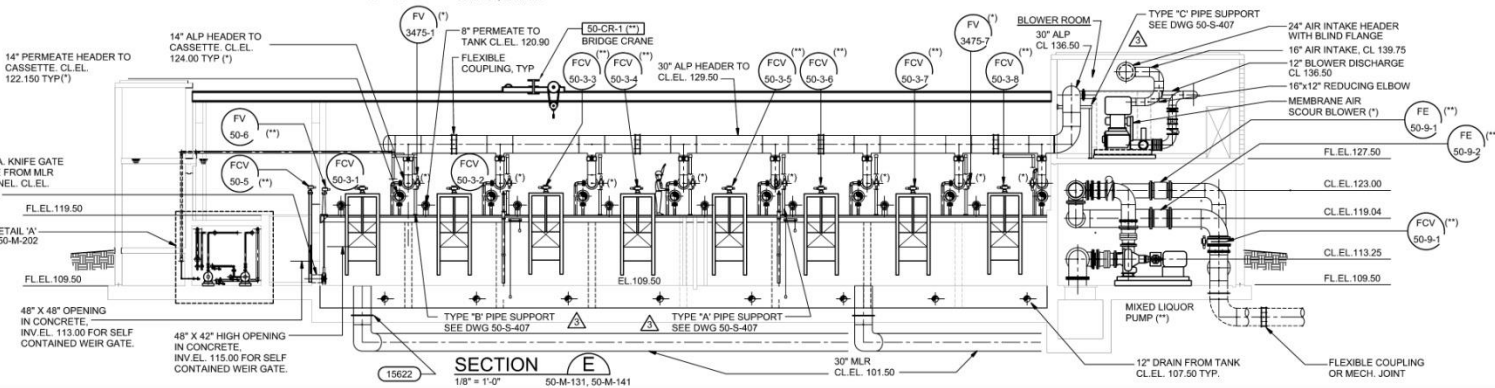
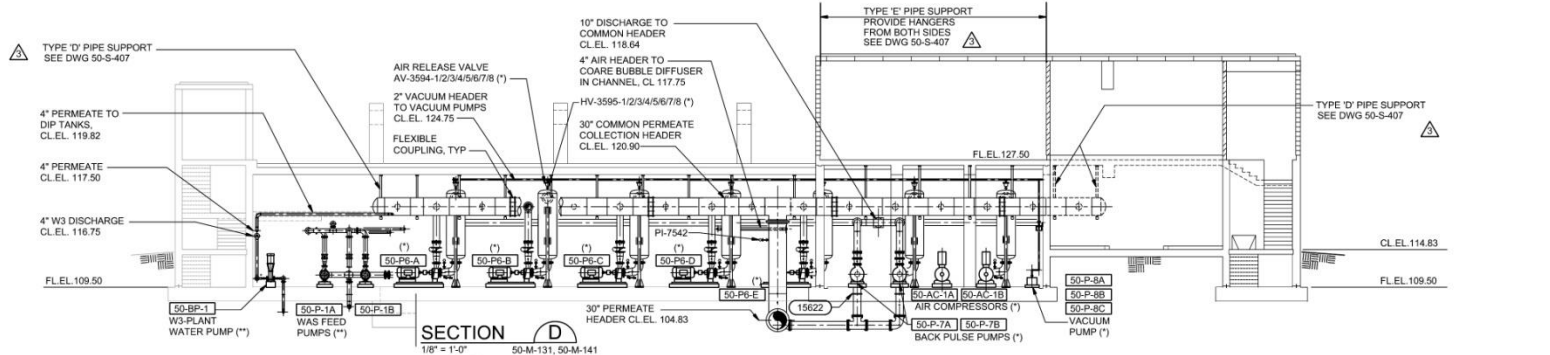
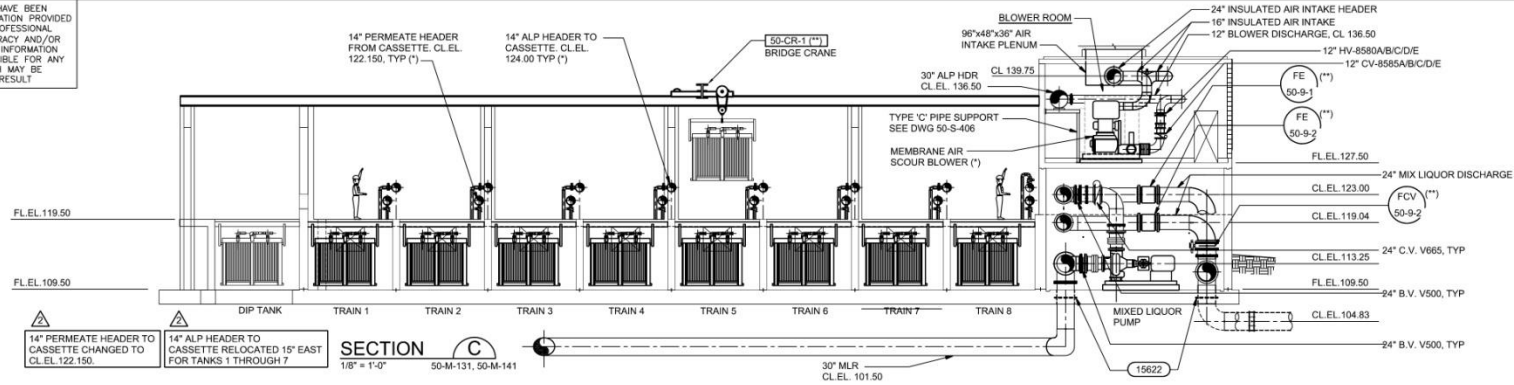




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# Membrane Cost Increase Since 2004

## New 500C Modules in new Cassette Frames

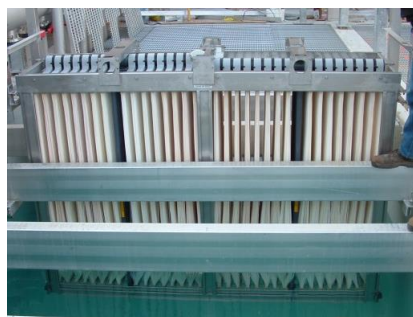
Item	2002	2013
Canadian Consumer Price Index	100.0	123.1
Membrane modules	\$377,700	\$465,000
Membrane cassettes (assumed)		\$100,000
Warranty (2 years)		\$9,600
Hoses & miscellaneous parts		\$30,600
GE services		\$60,000
<b>SUBTOTAL</b>		<b>\$665,200</b>
Local sales tax @ 6% (rounded)		\$39,900
Module installation		\$10,000
Used module disposal		\$5,000
Used cassette salvage		-\$3,000
<b>TOTAL (rounded)</b>		<b>\$720,000</b>



# Membrane Replacement

- ZENON 500C membranes currently installed (500C32M)
- General Electric (GE) purchased ZENON in 2006
- GE uses 500D membranes for its latest designs
  - Will not manufacturer 500C membranes indefinitely; expectation is 2 to 4 more years
  - Standard 500D48M cassette will not fit at TCRWWTP
  - However, short 500D modules in smaller cassettes will fit

1-1/2 of these  
(500D16M + 500D8M)  
fill the space of one  
existing 500C32M  
cassette



500C32M  
(non-standard)



500C22M  
(standard)



500D48M  
(standard)



500D16M  
(standard)